UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/581,441	01/12/2007	Yasuhiko Kasama	8075-1097	6604

466 7590 12/09/2010
YOUNG & THOMPSON
209 Madison Street
Suite 500
Alexandria, VA 22314

EXAMINER	
DHINGRA, RAKESH KUMAR	
ART UNIT	PAPER NUMBER
1716	

NOTIFICATION DATE	DELIVERY MODE
12/09/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

DocketingDept@young-thompson.com

Office Action Summary	Application No.	Applicant(s)	
	10/581,441	KASAMA ET AL.	
	Examiner	Art Unit	
	RAKESH DHINGRA	1716	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 April 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *12-19 and 21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *12-19,21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 June 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 04/26/2010 has been entered.

Response to Arguments

Applicant's has amended claims 12, 13 and 21, e.g. in claims 12, 13 limitations of claim 20 have been added. Further, applicant has cancelled claims 20, 22.

Accordingly, claims 12- 19 and 21 are now pending and active.

Further, applicant's argument that the cited references by Gruen, Matsuoka, Sano etc do not teach electron energy control means producing a low temperature plasma from a high temperature plasma has been considered and found persuasive. Thus the rejection is withdrawn. However on further consideration a new ground of rejection is made in view of new references by Remo (US 5,132,105), Lee (US 5,279,669), Miyake et al (US 6, 335,535), and Appleyard (US 6,876,154) which when combined with Nakanishi read on limitations of amended claim 12 including electron energy control means for producing a low temperature plasma from a high temperature plasma (e.g. at least Miyake et al – Fig. 10). Accordingly, claims 12, 14, 16, 18, 21 have been rejected under 35 USC 103 (a) as explained below. Balance claims 13, 15, 17, 19 have also been rejected under 35 USC 103 (a) as explained below.

Further, in view of amendment to claims 12, 13 and amendment to claims of the copending application 11/659,201 the double patenting rejection is withdrawn.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 12, 14, 16, 18, 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Remo (US 5,132,105) in view of Lee (US 5,279,669), Miyake et al (US 6, 335,535), Appleyard (US 6,876,154) and Nakanishi et al (US 4,894,510).

Regarding Claims 12, 16, 22: Applicant has invoked 35 USC 112, 6th Paragraph in respect of claim limitations "means for generating high electron temperature plasma configured

to maintain an electron energy at 15 to 50 eV to generate a positive monovalent ion M^+ from a gas containing an atom M acting as a moiety in the production of a fullerene derivative", for which the applicant's disclosed structure is a plasma generating chamber 2 made from quartz having a plasma gas introducing port 6, microwave generator 5, a pair of coils 71, 72 located around external wall of the plasma generating chamber 2 that form a magnetic mirror, and a four phase control helical antenna 8 wound around a gap between the coils 71, 72 such that a an electron energy of 15-50 eV is generated {Figs. 1, 2 and Para. 0026};

Remo teaches a microwave plasma apparatus comprising: a plasma chamber including a plasma generating chamber portion and a plasma processing chamber portion wherein a substrate SU6 is processed. Remo also teaches a plasma gas inlet PA6 and a process gas inlet PI6. Additionally Remo also teaches a pair of magnetic coils MC6. Remo also teach that diamond like substances can be deposited on a substrate SU6 that is disposed in the processing chamber (e.g. Figs. 18, 19 and col. 7, line 60 to. 8, line 30). Further, Remo teaches a pipe PI6 through which fullerene can be introduced. Examiner notes that the claim limitations "electron energy control means for receiving and controlling the energy of electrons in the high electron temperature plasma to produce a low electron temperature plasma comprised of M^+ and electrons with an electron energy in a range of 1 to 10 eV, the electron energy control means being located downstream of the high electron temperature plasma generating means with respect to a flow of the high electron temperature plasma" and "fullerene introducing means for introducing a fullerene into the low electron temperature plasma comprised of M+ electrons to produce a fullerene ion", the absence of the term "means for" raises the rebuttable presumption that claim

limitations are not in means-plus-function form and thus are not to be interpreted according to 35 USC 112, sixth paragraph.

Remo does not explicitly teach the plasma apparatus generates high electron temperature plasma configured to maintain an electron energy at 15 to 50 eV to generate a positive monovalent ion M^+ from a gas containing an atom M acting as a moiety in the production of a fullerene derivative, the plasma generating chamber made from quartz, the magnetic coils establish a magnetic mirror, and a four phase helical antenna wound around a gap between the coils, and also do not teach electron energy control means for controlling the energy of electrons in a plasma to be in the range of 1 to 10 eV, the electron energy control means being located downstream of the high electron temperature plasma generating means in terms of the flow of plasma.

Lee teaches a microwave plasma apparatus comprising a quartz plasma generation chamber 82, magnetic coils 34 and an additional antenna 88 wrapped around the exterior of the plasma generation chamber that enables to obtain double resonance and obtain a highly dense plasma (i.e. having high electron temperature), that enables to obtain significant improvement in the ionization efficiency (i.e. the apparatus enable to generate high electron temperature plasma). Lee further teaches an extraction grid 60 located downstream of the high electron temperature plasma generating means that can be suitably biased to obtain desired species within the plasma processing chamber for processing a substrate 38 (e.g. Figs. 2-4 and col. 6, line 35 to col. 8, line 55).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide a quartz plasma generation chamber with an inductive antenna wound

around the plasma generation chamber as taught by Lee in the apparatus of Remo to obtain a high electron temperature plasma with significantly higher ionization efficiency.

Remo in view of Lee do not explicitly teach the plasma apparatus is configured to maintain an electron energy at 15 to 50 eV to generate a positive monovalent ion M^+ from a gas containing an atom M acting as a moiety in the production of a fullerene derivative, the magnetic coils establish a magnetic mirror, and a four phase helical antenna wound around a gap between the coils, and also do not explicitly teach that the electron energy control means for controlling the energy of electrons in a plasma to be in the range of 1 to 10 eV.

Miyake et al teach a plasma apparatus comprising a microwave plasma generating chamber 368 provided with an energy filter 369 that prevents introduction of high energy electrons generated in the plasma generation chamber from passing into the a second plasma chamber 370. Miyake et al further teach that electrons in the plasma generation chamber 368 have energy of about tens of eV, and after passage through the energy filter 369 electrons that pass through to the second plasma chamber have energy of about 1 eV to 0.1 eV. Miyake et al also teach that the energy filter can be made selective regarding electron energy levels to be transmitted, and that magnetic field required by the energy filter can be formed by passing electric currents in the plurality of conductive rods forming the energy filter (e.g. Fig. 10 and col. 11, lines 20-45 and col. 14, lines 26-36 and col. 19, line 40 to col. 22, line 10). It would be obvious to optimize the magnetic field strength of the energy filter in view of teaching of Miyake et al to enable control energy of electrons in the downstream plasma as per process limitations like type of process chemical to be deposited upon the substrate. Still further, since Miyake et al teach that electrons in the plasma generating area have energy levels of tens of eV, the apparatus

of Remo in view of Lee enables to produce high electron temperature plasma and with electrons having still higher energy levels considering that Lee teaches use of hybrid plasma generating means inclusive of both microwave as well as inductively coupled plasma (which would thus meet the claimed range of 15-50 eV).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide an electron energy control means and optimize its magnetic field strength as taught by Miyake et al in the apparatus of Remo in view of Lee to control energy of electrons in the high temperature plasma as per process limitations like type of process chemical to be deposited upon the substrate.

Further, claim limitations "generate a positive monovalent ion M^+ from a gas containing an atom M acting as a moiety in the production of a fullerene derivative, whereon a fullerene derivative produced as a result of a reaction between the fullerene ion and M+ is deposited", are functional limitations, and since the structure of the prior art apparatus meets the structural limitations of the claim, the same is considered capable of meeting the functional limitation.

Further, it has been held that:

Claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function. In re Danly, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959).

Remo in view of Lee and Miyake et al do not explicitly teach the magnetic coils establish a magnetic mirror, and a four phase helical antenna wound around a gap between the coils.

Appleyard teaches a microwave plasma apparatus wherein coils plasma apparatus comprising 1, 2 are provided around a plasma generation chamber 15 with a gap between the

coils which enables to confine the plasma electrons within the plasma generation chamber (e.g. Fig. 6 and abstract).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide the magnetic coils as magnetic mirror as taught by Appleyard in the apparatus of Remo in view of Lee and Miyake et al to enable confine the plasma electrons within the plasma generation chamber.

Remo in view of Lee, Miyake et al and Appleyard do not explicitly teach a four phase helical antenna wound around a gap between the coils.

Nakanishi et al teach an ECR plasma apparatus comprising four phase antenna coils 14a-14d wound around a plasma generation chamber that enable the magnetic fields induced by the four phases to rotate and the intensity of such magnetic field can be controlled by changing the magnitude of currents flowing through the four coils of the antenna (e.g. Figs. 4, 7 and col. 3, line 65 to col. 5, line 25). It would be obvious to dispose the four phase antenna between the pair of coils forming the magnetic mirror to enable confine the magnetic field formed by the four-phase plasma within the plasma generating chamber.

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide a four phase antenna as taught by Nakanishi et al in the apparatus of Remo in view of Lee, Miyake et al and Appleyard to enable control the radius of the rotating magnetic field for the ECR plasma generation.

Regarding Claim 14: Remo in view of Lee, Miyake et al, Appleyard and Nakanishi et al teach a pair of coils 1, 2 for generating a mirror magnetic field (Appleyard - Fig. 6).

Further, claim limitation "which prohibits the dispersion of positive ions produced" is an intended use limitations, and since the structure of prior art meets the structural limitations of the claim, the same is considered capable of meeting these limitations (relevant case law already cited above under claim 12).

Regarding Claim 18: Remo in view of Lee, Miyake et al, Appleyard and Nakanishi et al teach all limitations of the claim (as already explained above under claims 12, 14, 16) including plasma gas introducing means PA6, a microwave generator (waveguide WG6 (Fig.-18, Remo), coil pairs 1, 3 as a magnetic mirror (Appleyard – Fig. 6) and a four phased helical antenna 14a-14d (Nakanishi et al – Fig. 4).

Further, claim limitations "which prohibits the dispersion of positive ions produced" is an intended use limitations, and since the structure of prior art meets the structural limitations of the claim, the same is considered capable of meeting these limitations (relevant case law already cited above under claim 12) {relevant case law already cited above under claim 12}.

Regarding Claim 21: Remo in view of Lee, Miyake et al, Appleyard and Nakanishi et al teach the electron energy control means is a plurality of conductive rods (as an electrode) which controls the energy of electrons by applying a current to rods 369 (i.e. applying control voltage to an electrode) located upstream of the fullerene introducing means PI6 (e.g. Miyake et al – Fig. 10 and Remo – Fig. 18).

Further, claim limitation "for manufacturing a fullerene derivative" is a functional limitation, and since the structure of the prior art apparatus meets the structural limitations of the claim, the same is considered capable of meeting the functional limitation (relevant case law already cited above under claim 12).

Claims 13, 15, 17, 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Remo (US 5,132,105) in view of Lee (US 5,279,669), Miyake et al (US 6, 335,535), Appleyard (US 6,876,154) and Nakanishi et al (US 4,894,510) and Dearnaley (US 5,393,572).

Regarding Claims 13, 17: Remo in view of Lee, Miyake et al, Appleyard and Nakanishi et al teach all limitations of the claims (as already explained above under claims 12, 16) including that the low temperature plasma is directed against the substrate SU6 (at least Remo – Fig. 18, Miyake et al – Fig. 10) but do not explicitly teach the fullerene ejected by the fullerene introducing means is allowed to impinge at the same time onto the deposition substrate so that M+ and fullerene react with each other to produce a fullerene deposit on the deposition substrate.

Dearnaley teach a deposition apparatus where a fullerene stream 25 is directed towards a substrate 22 so that the fullerene stream impinges on the substrate and reacts with the low electron temperature plasma to produce a diamond coating on the substrate (e.g. Fig. 1 and col. 3, lines 40-55). It would be obvious for the low temperature plasma of Remo in view of Lee, Miyake et al, Appleyard and Nakanishi et al to react with the fullerene impinging upon the substrate and produced a desired coating on the substrate.

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide the gas introducing means that directs the gas towards a substrate as taught by Dearnaley in the apparatus of Remo in view of Lee, Miyake et al, Appleyard and Nakanishi et al to enable control the deposited film properties.

Further, claim limitation "so that M+ and fullerene react with each other to produce a fullerene deposit on the deposition substrate" is an intended use limitation and since the structure of prior art meets the structural limitations of the claim, the same is considered capable of meeting these limitations (relevant case law already cited above under claim 12 above).

Regarding Claim 15: Regarding Claim 14: Remo in view of Lee, Miyake et al, Appleyard and Nakanishi et al teach a pair of coils 1, 2 for generating a mirror magnetic field (Appleyard - Fig. 6).

Further, claim limitation "which prohibits the dispersion of positive ions produced" is an intended use limitations, and since the structure of prior art meets the structural limitations of the claim, the same is considered capable of meeting these limitations (relevant case law already cited above under claim 12).

Regarding Claim 19: Remo in view of Lee, Miyake et al, Appleyard, Nakanishi et al and Dearnaley teach all limitations of the claim (as already explained above under claims 12, 14, 16) including plasma gas introducing means PA6 (Remo – Fig. 18), a microwave generator (waveguide) WG6 (Remo – Fig. 18), coil pairs 1, 2 –Fig. 6 – Appleyard) and a four phased helical antenna 14a-14d (Nakanishi et al – Fig. 4).

Further, claim limitation "which prohibits dispersion of the positive ions produced" is an intended use/functional limitations, and since the structure of prior art meets the structural limitations of the claim, the same is considered capable of meeting these limitations (relevant case law already cited above under claim 12).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RAKESH DHINGRA whose telephone number is (571)272-5959. The examiner can normally be reached on 8:30 - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/RAKESH DHINGRA/
Examiner, Art Unit 1716